

**State of Kansas**

**CONSTRUCTING GUIDELINES FOR CLOSED LOOP HEAT PUMP WELL**

**(1) Casing Material.** Permanent casing is needed in a heat pump well, it must meet standards set out by ASTM and the plastic must be grouted full-length of the bore hole.

**(A) High Density**

**Polyethylene Pipe.** This pipe must be manufactured in accordance with dimensional specifications of ASTM D-2513 or ASTM F-714 and have a minimum cell classification of PR 345434C or PE 355434C when tested under ASTM D-3350 to be acceptable for use in closed-loop heat pump systems.

**(B) Polyethylene Pipe.**

This pipe must be manufactured in accordance with ASTM D-2581. The pipe must be -

1. Either Class B (general purpose and dielectric, in colors) or Class C (weather resistance, black in color containing not less than (2%) carbon black);
2. Type II (density, ninety-one thousands to ninety-two (.0091 - .0092) grams per centimeter (g/cm);
3. Grade 1. (flow rate twenty-five thousands to seventy-five thousands (.0025 - .0075) gallons per ten (10) minutes (g/10 min).

**(2) Connecting Closed-Loop Pipe.**

Polyethylene and polybutylene pipe must be thermally fused according to the pipe manufacture's specifications and must not leak after assembly.

**(3) Heat Transfer Fluid.**

The fluid used inside the closed-loop assembly must be approved by the department and meet the following standards:

**(A) Heat transfer fluids must be composed of-**

1. Pure glycerine solutions-glycerine must be ninety-six and one-half percent (96.5%) United States pharmacopeia grade;
2. Food grade propylene glycol;
3. Dipotassium phosphate;

4. Sodium Chloride;
5. Potassium acetate;
6. Methanol;
7. Ethanol; or
8. Other fluids may be used if approved by the department is received in advanced with appropriate documentation.

**(B)** The fluid as it is used in a diluted state in the closed-loop must have the following properties:

1. Be ninety percent(90%) biodegradable;
2. Demonstrate low corrosion to all materials common to ground source heat pump systems;
3. Have a freezing point that exceeds minus twenty three degrees Celsius (-23°C);
4. Be homogenous, uniform in color, free from lumps, skins and foreign material would be detrimental to the fluid usage;
5. Not have a flash point lower than ninety degrees Celsius (90°C);
6. Not have a five (5)-day biological demand (BOD) at ten degrees Celsius (10°C) that exceeds more than two-tenths (0.2) gram oxygen per gram nor be less than one-tenth (0.1) gram per gram;
7. Not have a toxicity that is less than lethal dose (LD) fifty (50) oral-rats of (5) grams per kilograms; and
8. Show neither separation from exposure to heat or cold, nor show an increase in turbidity; and

**(C)** While this rule attempts to define antifreeze fluids that will protect the environment, it is the responsibility of the driller to become familiar with safe and proper use of these fluids and to take proper use of these fluids and to take necessary precautions to ensure groundwater protection.

#### **(4) Hole Size.**

The hole size for heat pump wells that are grouted full-length with high solids bentonite slurry must be of sufficient size to allow placement of a tremie pipe to emplace the high solids bentonite slurry. The slurry must fill the hole and surround all pipes. There must be at least one-half inch ( $\frac{1}{2}$ " ) between the hole and all pipes. If full length high solids bentonite slurry is not used, then the following hole sizes are required.

(A) At least a five inch (5") borehole when the loop pipe is less than one inch (1") in diameter.

(B) At least a six inch (6") borehole when the loop is one and a quarter inch ( $1\frac{1}{4}$ " ) or greater in diameter;

#### **(5) Hole Depth.**

Closed-loop heat pump wells have no limit as to how far the well bore can be drilled however all formations that are encountered that penetrates an aquifer containing water with more than 1,000 milligrams per liter, (mg/l), total dissolved solids or is in an area determined by the department to be contaminated, the entire hole shall be plugged with an approved cement grout. **A note shall be placed on the WWC-5 well log stating what type of contamination was encountered.**

#### **6) Heat Pump System Design.**

The heat pump system that utilizes wells must be designed so that the grout used to seal the wells does not dehydrate because of excessive heat caused by an improperly designed heat system.

##### **(1) Grouting Depth of Vertical Heat Pump Wells**

Grouting the annulus of a heat pump well is very important and must be completed immediately after the well is drilled due to cave-in potential. K.A.R 28-30-7 (3) *Plugging of heat pump wells for closed heat pump systems. The entire hole shall be plugged with an approved grouting material from bottom of the hole, to the bottom of the horizontal trench, using a grout tremie or similar method approved by the department.*

##### **(2) Approved Grout Materials.**

The following three (3) grout types are permitted for use in heat pump wells;

(A) Neat cement grout, a mixture consisting of one ninety four (94) pound bag of portland cement to five to six gallons of clean water. ASTM-C150, TYPE I

(B) Cement Grout, A mixture consisting of one ninety four (94) pound bag of portland cement to an equal volume of sand having a diameter no larger than 0.080 inches (2 millimeters) to five to six gallons of clean water. ASTM-C150, Type I

**(C) Bentonite Clay Grout, a mixture consisting of water and commercial grouting or plugging sodium bentonite clay containing high solids such as that manufactured under a number of trade names of bentonite grout, approved by the department.**

1. The mixture shall be as per the manufacture's recommendations to active a weight of not less than nine pounds four ounces (9.4) per gallon of mix. Weighted agents may be added as per manufacture's recommendations.

2. Bentonite hole plug chips will not be allowed.

3. Sodium bentonite products that contain low solids, are designed for drilling purposes, or contain organic polymers shall not be used.